

Surveys in Private and Communal Forests: Data Collection Methods in Bavaria

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Abstract More than half of the forest land in Bavaria belongs to private forest owners, who contribute a large amount of the industrial timber supply. The level of information about private forests is in comparison to the communal forests inadequate. The increasing demand for data about the forest sector in Bavaria can be partially covered by regular inventories but requires supplementary monitoring activities. Regular surveys based on voluntary participation deliver data, but often do not fulfil statistical requirements due to low response rates of 15–20% to postal surveys. The Bavarian annual postal cutting survey has been built up over 5 years using a roster of voluntary participants. This pragmatic and cost-effective approach provides reliable data for statistical purposes and gives insight in the forest management activities of small-scale forest owners. Recent technical developments, in particular the availability of grids and digital land-use maps, facilitate the random sampling of forest owners. This approach has been applied in a climate change project, but the results did not meet the expectations because of low response rates. The rather labour- and cost-intensive census of forest owners as applied in the project in Eastern Bavaria cannot be recommended except in exceptional circumstances. In the described project a qualitative approach with four distinct questionnaires has been adopted in order to identify ways to reach forest owners that are either not interested in their forests or do not respond to requests. Due to low response rates the objectives of the study could only be partially achieved.

Keywords Forest ownership structure · Use of grids · Random sampling · Attitudes of private forest owners

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Introduction

Reliable data about the forest sector are necessary to serve as a basis for decision-making in policy, forest administration, forest owner associations and the timber industry. The timber industry is interested in the extent to which a sustainable supply of the timber resource is guaranteed, in order to adjust the production capacity. Policy and forest administration need information about the impact of support programs and extension services on forest owners and about the forest owners themselves, i.e. their attitude towards forest and knowledge about forestry.

In order to meet these demands regular inventories and surveys are carried out in Bavaria. These are justified partly based on legal regulations under *Federal and State Forests Acts* (in relation to Forest Accountancy Networks, National Forest Inventory and Inventory on Game Browsing in Bavaria) and under the *Agricultural Statistics Act* (e.g. structure of forest ownership, statistics on annual cutting in forests).

The Forest Accountancy Network of the Federal Ministry of Agriculture in Bavaria is designed to collect economic data of forest enterprises with forest area of 200 ha and more. The survey on the annual cutting in Bavaria primarily serves the purpose of delivering information on cutting and selling activities, but also gathers data on the management activities as well as economic performance. Recent studies show that in Bavaria the annual cut is less than the increment of wood, in particular in private forest in the size range of 20 ha and less (Borchert 2005), which led to an increase of growing stock.

This paper is designed to provide insights into data gathering methods for forest enterprises in Bavaria, focussing more on the practical problems and general forest conditions and less on the theoretical, scientific aspects of the quantitative and qualitative methods and approaches described in relevant scientific papers (Schnell et al. 1995; Schaffner 2001; Atteslander 1995).

The survey on the annual cutting is used as an example to describe the ways and means to build up a cost-effective survey within the given specific framework (i.e. unknown basic population of forest owners, voluntary participation) and to present the revealing results of the survey. The use of grids in combination with recent technical developments (digital land register map) is presented as a tool to design a survey that is meeting the statistical demands. The survey of all forest owners in a particular territory described in this paper is an exception and not a standard method in Bavaria.

Structure and Accessibility of Forest Ownership in Bavaria

One third of Bavaria is covered in 2.45 M ha of forest. About 30% of the forest area belongs to the state of Bavaria, 2% to the Federal Republic, 11% to communal groups and 57% to private owners (Bayerischer Agrarbericht 2008). Data about private forest owners differs depending on the database used. Since 1998, the agricultural statistic database has only recognised forest owners with properties greater than 10 ha, leaving about two-thirds of forest owners statistically unregistered.

The number of forest owners in Bavaria is not known because the forest owner directories are out of date and the use of such information is restricted by data privacy laws. Based on the available forest owner directory of the forest administration it is estimated that there are currently about 635,000 private forest owners in Bavaria. At present the forest administration and its rangers, who supervise forests in their districts, have online access to the land survey register allowing them to identify individual forest owners and contact them about specific forest protection issues, e.g. bark beetles.

One of the common problems for the Forest Administration and researchers is to access forest owners that are either not interested in their forest or are living far away from it. The forest administration notes a response rate to non-legal enquiries of about 30% through personal contact (forest ranger) or 15–20% through postal contact. Whereas the Forestry Administration often wants to deliver expert advice, the research needs to gather reliable data through regular surveys.

In the course of continuing projects, various methods have been and are being tested to increase the survey response rate of forest owners. Because the basic population of forest owners is unknown, common statistical methods, particularly random sampling from a list of all forest owners, cannot be applied, hence alternative methods are needed.

Various data collection approaches are described in this paper, drawing on examples from the survey of the annual cutting in private and communal forests, the regional climate change project in Bavaria (use of grids), and a small-scale forestry project in eastern Bavaria (which has involved complete survey of all forest owners).

Experiences from the Annual Cutting Survey in Private and Communal Forests

In accordance with legal regulations the state of Bavaria has to report the annual cut in forests to the Federal Office of Statistics. Until 1995 this reporting was conducted by the individual forest offices. Whereas the data for the federal and state forests could be gathered reliably, the data for private and communal forests was rather vague and uncertain. Therefore, the Institute of Forestry (LWF) in cooperation with the Technischen Universität München (TUM) was asked by the Ministry for Agriculture and Forestry to develop an improved survey for privately owned forests. The Bavarian associations of forest owners and the Bavarian association of farmers were involved in this process from the start because both had to agree to the survey method in order to avoid overburdening forest owners with reporting commitments. Therefore the data collection had to meet the conditions of procedural simplicity, low data gathering cost, voluntary participation and annual repeatability.

In 1999 a short (one page) questionnaire was developed and distributed to private forest owners in various ways, with response rates as summarized in Table 1. Out of 380 questionnaires distributed by forest rangers through personal contact 111 or 30% were returned. In contrast, there was a low rate of return for questionnaires distributed in the farmers journal, where only 59 (0.05%) of the 100,000 enclosed

Table 1 Distribution methods of questionnaires and response rates of private forest owners to surveys in 1998 (rangers only) and 1999

Method of distribution	Number distributed	Number of responses	Response rate (%)
Farmers' association journal	107,500	59	0.05
Journal forest owner association	3,000	64	2.13
State Institute of Agriculture	110	9	8.18
Participants in the federal accountancy network	165	5	3.03
Schools of Agriculture	1,180	121	10.25
Rangers (1998)	380	126	33.16
Rangers (1999)	380	111	29.21
School of Forest Farmers	50	0	0

questionnaires were sent back. Nevertheless, between 2000 and 2005 it was possible to build up a directory of about 1,500 private forest owners who were willing to participate continuously in this annual survey (return rate about 1,100). Since 2006 only these owners have been contacted for the surveys in 2007, 2008 and 2009. Building up this register of private forest owners did not strictly follow the principles of random sampling; it could be better characterized as a pragmatic approach.

In 2006 the survey was extended to communal forest owners. In cooperation with the Ministry for Agriculture and Forestry, the Bavarian State Institute of Forestry could draw a random sample of 10% of the existing directory of all communal forests. Initial contact with the communities was established by the regional state forest offices. However, out of the 325 communal forests selected, only 212 answered and only 115 were willing to participate again. Therefore, the random sampling had to be repeated. At present about 180 communal forests are listed in the directory.

The main purpose of these two surveys in the private and communal forests has been and still is to obtain reliable data about the annual cutting and selling of timber in Bavaria for the Federal Office of Statistics. The annually used questionnaire for both surveys is the same and always contains the same questions relating to the statistical data. It also enables two to three additional questions of interest to the Forest Administration to be asked. The categories of basis and additional data sought are listed in Table 2.

The first results of the survey have been discussed intensively because the figures on the annual cutting in private forests seemed to be too high. Between 1988 and 2002 the official statistics based on estimates of forest rangers indicated an average of $4.93 \text{ m}^3/\text{ha}$, while the survey for 1999 to 2002 indicated an average of $7.39 \text{ m}^3/\text{ha}$. But the results of the forest inventory 2002 in Bavaria with an average cutting of $8.38 \text{ m}^3/\text{ha}$ between 1988 and 2002 confirmed the results of the survey.

The 2002 forest inventory showed a high volume of stands, particularly in private forests with property sizes of less than 20 ha. The survey on the annual cutting can

Table 2 Structure of the questionnaire for private and communal forest owners

Basic statistical data	Additional data
Cutting and selling of timber	Administrative district
Their four main tree species	Occupation or profession
Volume sold in four timber grades	Willingness to participate in the survey next year
Wind and insect damage	Whether a member of WBV or FBG ^a
Size of forest area	Forest operations, including whether use harvester
	Marketing
	Need for extension
	Subsidies received
	Contracting out

^a WBV (Waldbesitzervereinigung) and FBG (Forstbetriebsgemeinschaft) are regional forest associations, voluntary self-help organisations focused on improving the market position of small-scale forest owners

answer the question of whether the concerned forest owners are aware of their stock of wood and if they are prepared to use their forest resource. As forest inventories are carried out every 10 years, regular surveys in between inventories are an important source of information.

The Use of Grids in the Climate Change Project in Bavaria

In the context of climate change, the state of Bavaria has provided funds to support forest owners in their efforts to prepare forests for the future. However, it is not known to what extent forest owners intend to accept the advice and recommendations provided or what they are planning to do at all in their forests.

The regions in Bavaria where forest stands will have to be adjusted in order to avoid the problems expected to be caused by climate change are already known in broad terms, but it is difficult to identify individual forest owners who will be affected. Due to the lack of an up-to-date directory, alternative approaches are required to enable a survey based on random sampling. Information on forest owners' intentions is being sought through a random sample survey of forest owners in the concerned regions.

Technical developments in recent years have given rise to some options which are useful for efficient and representative sampling. The use of grids is a well established procedure in Germany that is mainly applied in the context of inventories, e.g. forest inventories (Loetsch et al. 1973). All the 10.4 M property plots are available on a digital land register map. In combination with a systematic grid (standard 8 × 8 km, intensified 4 × 4 km) it is possible to carry out simple random sampling to identify a limited number of plots. Forest owners can then be identified by the responsible forest office. Figure 1 shows a land register map with the property plots (blue), the forest area (green) and the grid to select the plots randomly. The necessary GIS shapes are available at the Bavarian State Institute of

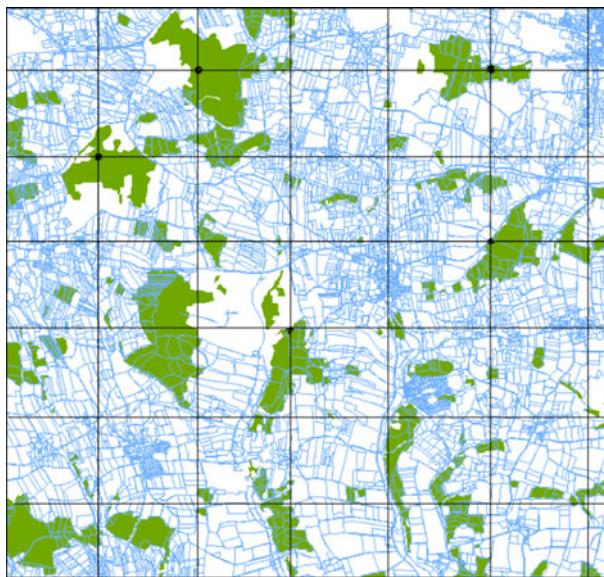


Fig. 1 Example of a grid on a digital land register map of Bavaria (green/gray forest area, blue/gray lines property plots)

Forestry and can be processed with standard GIS programs including ARC GIS. The grid itself has already been created for another inventory in Bavaria.

In 2009 a random sample of 1,000 forest owners was identified with the grid method, sample points being indicated by bold points of intersection in the green forest areas in Fig. 1. The owners were sent a questionnaire on annual cutting, supplemented with questions about climate change. However, the intention to verify the results of the annual cutting survey could not be realized, because only 180 out of 1,000 owners completed and returned the questionnaire.

Complete Survey of all Forest Owners, as Used in the Small-Scale Forestry Project in Eastern Bavaria

A rather labour-intensive alternative approach to data collection has been trialed in the small-scale forestry project of the Institute of Forestry in eastern Bavaria. In order to identify ways and means of reaching private forest owners that are either not interested in their forests or do not respond to requests, a census of all forest owners in four districts in eastern Bavaria was undertaken.

In accordance with the objective of the project, four distinct questionnaires were developed to address different types of forest owners, their interests and their attitudes towards their own forest adopting quantitative and qualitative questioning methods of empirical social research (Schnell et al. 1995). The questionnaires were developed jointly by the Technischen Universität München (TUM), Chair of Forest and Environmental Policy and the Agricultural Employers' Liability Insurance

Association (LBG). Questionnaires 1 (general perception of forests) and 2 (ownership as a motivator of active forest management) covered aspects of how to obtain access to forest owners who are less interested in their forest and what is their motivation to manage their own forest. Both questionnaires reflect and supplement the research activities of the TUM. Questionnaires 3 (activities in their own forest) and 4 (operational safety in forests) covered the aspects of safety at work, reflecting the field of activities and interests of the LBG.

As the Bavarian Forest Service's directory of forest owners is more than 8-years-old, the Bavarian State Institute of Forestry co-operated with the LBG, which has an up-to-date register of all forest owners because all are members of the LBG. The association agreed to distribute the questionnaires to all forest owners in four project districts by allocating the different questionnaires randomly to the addresses of the forest owners.

A total of 38,770 questionnaires were distributed, and a response rate of 17.5 % (6,807 usable questionnaires) was achieved. This is a normal but not particularly high response rate for postal surveys. The expense and amount of work required for this survey was extraordinary high and could only be justified by the unique character of this project. For standard surveys, in particular repeated surveys, sampling is strongly recommended to reduce overall costs.

Results of the Survey of Annual Cutting in Bavaria

Timber Cutting and Selling Activity

Bavarian forest owners felled about 21.2 M m³ in 2007, approximately 0.6 M m³ more than the previous year. The contribution of the various forest owner types is listed in Table 3. The distribution follows more or less the proportions in the ownership structure in Bavaria. The communal and federal forests together accounted for 2.3 M m³, the state forest 6 M m³ and private forest owners reported 12.7 M m³.

At about 6.8 M m³, the largest portion of the cutting comes from small private forests of 10 ha or less. This category comprises about 60% of the private forest area in Bavaria. The average cutting in private forests—over all size ranges—is about 8.7 m³/ha. The current utilization of the resource timber does not endanger the sustainability of Bavarian forests. Despite the storm damage of about 4 M m³ caused by 'Kyrill' in spring 2007, the total annual cutting was only 3% more than in

Table 3 Annual cutting in Bavaria according to ownership group (M m³)

Forest owner group	2006	2007
Federal forest	0.31	0.35
State forest	5.65	6.05
Communal forest	1.87	1.98
Private forest	12.71	12.78
Total cutting	20.56	21.17

Table 4 Cutting and potential in Bavaria (M m³)

Annual increment and potential	Private forest	State forest	Communal forest
Annual increment 1987–2002	15.1	7.6	3.3
Annual cutting 1987–2002	8.4	5.2	2.2
Cutting 2007	12.7	6.0	1.9
Annual potential 2003–2032	12.7	5.8	2.3

2006. Due to the poor timber market at the end of 2007, forest owners reduced the cutting of conifers (mainly spruce) Table 4.

According to calculations based on the 2002 forest inventory, the annual harvest potential of the forests is reached but not exceeded (Borchert 2005). The large contribution to the annual cutting from private forests is explained by them having the highest volume of stands (434 m³/ha, especially for forests less than 20 ha in area) and the highest share of forest land of all forest ownership types and advantageous market conditions, that encouraged more forest owners to bring timber to the market. However, only 56% of the cutting or 8 M m³ from private forests is for sale, the rest being consumed by the forest owners themselves. In particular, forest owners with small forests often do not appear in the market. They mainly produce fuelwood or chips for their own heating at home or sawlogs if they are farmers and need to replace a farm building.

In Bavaria only 30% of private forest owners (holding 68% of the private forest area) are members of a forest association and are able to compensate for the small amount of timber they produce by joining the bigger selling contracts of regional forest associations which achieve higher timber prices. Therefore forest owners often prefer products and assortments which they can process and use themselves, such as fuelwood and chips.

The share of sold timber increases with the size of the forest. As Table 5 reveals, forest owners of 50 ha or more sell nearly 100% of their annual cut, with a higher share of sawlog. Whereas the share of sawlogs in the forest size range of less than 10 ha is below 50%, it rises consistently to almost 80% in forest companies with more than 200 ha of forest. This is at the expense of fuelwood, which falls from about 40–45% to 10% or less.

Table 5 Cutting and selling of timber in private forests in Bavaria (M m³)

Forest area (ha)	Cutting volume, 2007	Sale volume, 2007	Timber sold (%)
0–10	6.83	3.35	49
10–20	1.89	1.29	68
20–50	1.00	0.71	71
50–100	0.60	0.55	92
100–200	0.34	0.29	85
200–500	0.55	0.45	82
500–1,000	0.54	0.49	91
More than 1,000	1.01	0.89	88

The 2007 cutting in Bavaria for all forest owners was composed of 61% conifer sawlog (spruce, scotch pine), 3% broadleaved sawlog (beech, oak), 9% pulpwood, and 27% fuelwood and woodchips.

In 2006 and 2007 the amount of sawlogs (13.26 M m^3) and pulpwood (1.8 M m^3) remained more or less the same. But there was an increase of 1.23 M m^3 of wood for energy purpose (fuelwood and woodchips) with a total of 5.57 M m^3 produced in 2007. In particular, beech and pine are being increasingly used for thermal purposes.

A comparison of the four forest ownership types shows the highest share of fuelwood and chips (36%) is from the private forest, the highest share of sawlog (77%) is from the state forest, and the highest share of pulpwood (33%) is from the federal forest (Fig. 2). The high percentage of pulpwood from federal forests is due to their location in military drill grounds and the ensuing damages caused by heavy military equipment exercises.

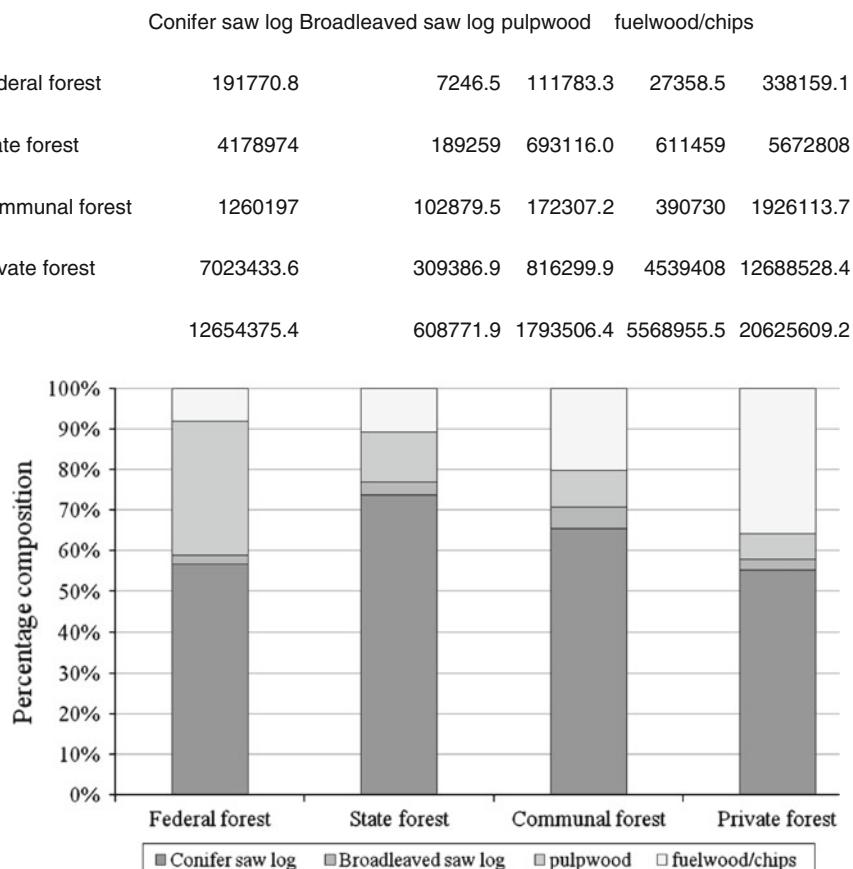


Fig. 2 Assortment and forest ownership

After publishing the results of the forest inventory in 2002 much effort has been put into the mobilization of the forest owners, in particular owners of small forest areas. The capacities of the timber industry have been expanded and ensuing improving market conditions have led to a continuous increase in the annual cut. It seems that the peak has now been reached because the annual cut in 2007 remained the same as in 2006. Still, a substantial portion of the wood produced does not appear in the market and is consumed by individual owners. Taking into consideration the high volumes of stands in the small forests in Bavaria, there are still resources that could be brought to the market (Schaffner 2001).

Subcontracting Forest Management

Over the last few years, the structure of forest ownership and the forest owners themselves have changed. Previously forestry was combined with farming, which ensured that the owners were knowledgeable about forest management, had the necessary equipment and were able to do most of the work themselves. Due to the lack of profitability or of a successor many farmers gave up farming and rented out their agriculture land. Often the forest land was kept because the owners were emotionally connected with it. In other cases the forest was inherited by several heirs, which meant that the land was split up between people who are interested in the forest to a greater or lesser extent and may live far away from it. These new owners do not have the knowledge or equipment to work in the forest. Many of the estimated 700,000 forest owners in Bavaria own very small areas of forest, the average forest holding size being only 2.8 ha. Often the shape of the forest is not favorable for forest management, e.g. long strips 5 m wide.

Various solutions have been developed to overcome the above-mentioned problems. Sometimes forest owners agree to a common management regime for their forests. Often regional forest owner associations or local contractors offer varying individual management services. Contracts may include complete forest management or only specific aspects such as harvesting operations or the regular inspection of stands.

Participants of the annual cutting survey were asked whether they are planning to subcontract the management of their forest to the regional forest owner association (e.g. FBG, WBV). Considering that this subcontracting option has been discussed in Bavaria for many years, it is surprising that some forest owners still do not know about it. Of 1,100 private forest owners, 18–32% over forest area classes can imagine subcontracting in the future. Owners of larger forests seem slightly more interested than owners of smaller areas. Still, 700 owners are not interested in subcontracting at all (Table 6).

Extension Services to Forest Owners

The changes in the ownership structure of private forest described above, accompanied with the loss of knowledge and skills, are substantial challenges for the Forest Service and forest owner associations. Currently, in connection with climate change much effort is being made to deliver important information and

Table 6 Willingness of private forest owners to subcontract their forest management

Forest area size range (ha)	Not interested	Did not know about option	Imaginable in future	Did not answer
0–1	32	1	7	4
1–5	196	19	59	19
5–10	159	24	78	12
10–20	171	12	51	16
20–50	103	6	39	14
50–100	21	3	10	4
100–200	18	0	9	1
Forest owners (total)	700	65	253	70

Table 7 Extension and consultancy services provided to private forest owners (2007)

Forest area size range (ha)	FBG/WBV (%)	Ranger (%)	FBG and ranger (%)	Contractor (%)	No extension (%)
0–1	27	24	17	0	32
1–5	29	22	24	2	22
5–10	29	19	37	1	14
10–20	30	12	39	1	18
20–50	27	21	41	1	10
50–100	8	27	46	4	15
100–200	36	20	16	8	20

provide financial support for forest management to forest owners. The Forest Service is providing consultancy and extension services via forest rangers well distributed throughout Bavaria. This is even stipulated in the *Forest Act* and every forest owner can access these services. Major topics relate to the choice of tree species, forest legislation, forest protection (e.g. against bark beetles) and applications for subsidies. Talking directly to the forest owner often prevents development in the wrong direction and avoids cumbersome corrective measures.

Forest owner associations offer their members consultancy services at the operational level to strengthen the management skills of forest owners. But are forest owners prepared to receive these extension services? Participants of the cutting survey were asked whether they had already received consultancy services and from whom. About 70–90% of the forest owners in the size range up to 200 ha were found to receive forestry extension and consultancy services (Table 7). About 27% stated that they only received advice from the forest owner association, with 20% relying only on the local ranger as a competent adviser. A substantial number of respondents (31%) reported using the forest ownership association as well as the ranger. Contractors do not play an important role in terms of extension services; on average they are used by 2% of forest owners and seem to be of most interest to larger forest companies (50 ha and above). Owners of forests of under 1 ha had the highest rate of non-use of extension services (32%).

About 70% of forest owners were satisfied with the competence and availability of the extension services, 13% were dissatisfied and 17% did not answer this question. With respect to the frequency of the contact, 30% of the forest owners would like to see an improvement, 65% were dissatisfied and 6% gave no comment.

Conclusion and Prospects

The various forestry data collection methods applied share the common problem that only a small percentage of forest owners usually respond to surveys. In addition, the given preconditions in Bavaria, in particular the unknown numbers of forest owners, the voluntary participation in surveys and the necessity for cost-effective data collection have to be kept in mind.

The purpose of the annual survey on cutting and selling is first and foremost to deliver data for statistical reporting. It took a long time to build up a directory of private forest owners willing to participate voluntarily. The selection could therefore not strictly follow the statistical requirements of random sampling. However, it was possible to obtain a reasonably representative sample of an acceptable geographic and size range distribution in Bavaria. The first results between 1999 and 2002 had a high level of uncertainty, because previous figures on the annual cut indicated a much lower level. It was assumed that only forest owners with a high felling activity participated in the survey. This aspect was statistically taken into consideration by trimming the extreme values during data processing. Since 2006 the group of the private forest owners that have been contacted repeatedly for the survey remained the same. Over the years the extreme values (annual cut) have been found to decrease slightly. Even if the first motivation of forest owners to participate in the survey was a high felling activity, the forest owners now exhibit a normal expected forest management with an averaged level of activity. The voluntarily participating forest owners are highly motivated and deliver the required data consistently. However it has to be taken into consideration that there are going to be some changes in survey respondents, which will have an impact on the results in terms of data consistency. The annual repeated survey provides current statistical data and in conjunction with the additional questions can be used as a monitoring tool for private and communal forests. It is a simple and cost-effective survey method based on a panel of voluntary participants built up over 5 years. Together with other surveys, the impact of measures to activate forest owners (e.g. to increase felling activities) and the performance of forest owner associations can be assessed.

Longer-term considerations suggest the need for random sampling in order to obtain more representative results instead of having an unvarying group of survey participants. A positive side-effect would be avoiding 'survey fatigue' amongst permanent survey participants. However, carrying out a survey based on a statistically representative sampling method—such as systematic selection by the use of grids as adopted in the climate change project—faces the common problem of a low response rate, unless participation is compulsory. Also, carrying out a census all forest owners in a particular region cannot be recommended, unless in exceptional circumstances, because of the extremely high cost.

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